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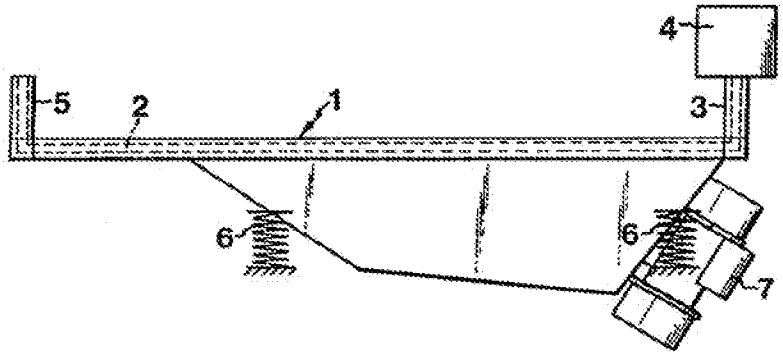

(57) Abstract

In a method for freezing the surface of one side of a food product, the product is placed on a supporting structure (1). This has previously been given such a low temperature that the product when contacting the supporting structure will not freeze on to it. The product is maintained on the supporting structure for a sufficient time to cause at least its surface layer nearest the supporting structure to pass into the frozen state. An arrangement for carrying out the method comprises, in addition to the supporting structure, also means for imparting to it the low temperature, such as means (2-4) for supplying a cooling agent to the underside of the supporting structure.

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METHOD AND ARRANGEMENT FOR FREEZING

The present invention relates to a method and an arrangement for freezing a food product.

For freezing food products, use is often made of freezing equipment in which the product is carried by some type of supporting structure during freezing. Once the freezing is completed, the product should be removed from the supporting structure, which in many cases involves substantial difficulties.

When using e.g. a freezing tunnel with a belt conveyor where the conveyor belt, in the form of a flat conveyor belt, feeds the product through the long freezing tunnel, the product will freeze on to the conveyor belt. It must then be scraped off or broken loose from the supporting structure, leaving remnants of the product frozen fast on the supporting structure. This freezing technique also requires considerable space, and the process cannot be modified or discontinued until the entire product has been transformed into solid ice phase.

When using e.g. a freezer with a foraminated conveyor belt, the product may also freeze on to the belt or receive impressions or be deformed by the belt.

Although it is previously known in the art, by different types of surface treatment, to try to prevent a product from freezing fast on e.g. a steel belt, these attempts have met with but little success.

The difficulties mentioned above, which are especially pronounced for products having soft consistency or a soft or moist surface, can however be overcome by stabilising at least one surface of the product before final freezing, whereby to obtain improved handleability of the product.

The object of the invention is to provide a method and an arrangement bringing about such stabilisation in an uncomplicated fashion by freezing at least one surface of the product, without, of course, any risk of the product

freezing fast on the belt.

According to the invention, this object is achieved by placing the product on a supporting structure which has previously been given such a low temperature that the product when contacting the supporting structure will not freeze on to it, maintaining the product on the supporting structure for a sufficient time to cause at least its surface layer nearest the supporting structure to pass into the frozen state, and removing the product from the supporting structure for final freezing in a separate freezer.

The invention relies on the presumably newly discovered phenomenom that there is no tendency whatever of the product freezing on to the conveyor belt when the temperature of the supporting structure becomes sufficiently low. The temperature at which this phenomenom appears depends on the nature of the product and thus varies with the composition of the product to be frozen. Hence, for each product there is a critical temperature below which this phenomenom can be brought about. The value by which the temperature should fall below the critical temperature in actual practice is dependent on the properties of the material of the supporting structure on which freezing should be performed, and on how the temperature decrease of the supporting structure is achieved.

It is thus likely that an increase of the water content of the product above a certain value entails a decrease of the critical temperature. The same probably also applies to a more liquid consistency of the product.

The properties of the material of the supporting structure which are most likely to affect the practical temperature required for avoiding that the product freezes fast on the conveyor belt are the thermal conductivity of the material and its heat capacity. This can probably be explained by the heat transfer process occurring during the time period counting from the moment the product to be

subjected to surface-freezing is placed on the supporting structure to the moment the portion of the product surface facing the supporting structure and making direct contact with the supporting structure when placed thereon has passed into the frozen state. During this time period, the temperature in the boundary between the product and the supporting structure should not exceed the critical temperature.

Thus, the temperature of the product itself immediately before it is placed on the supporting structure will of course also affect to some extent the temperature of the supporting structure required for preventing the product from freezing on to the supporting structure.

The object of the invention is also achieved by means of a device for carrying out the method according to the invention as defined above, which is characterised by a firm supporting structure on which the product is intended to be placed, means for giving the supporting structure such a low temperature that the product when contacting the supporting structure will not freeze on to it, and a separate final freezer to which the product is intended to be fed for final freezing as soon as its surface layer nearest the supporting structure has passed into the frozen state.

The cooling agent used may be e.g. a cryogenic gas or a secondarily cooled eutectic solution (cooling brine), or a directly-expanding refrigerating compressor technique can be used.

The invention provides a technique for conveniently stabilising the surface of the product making contact with the supporting structure and, hence, the entire product, which thus becomes easier to handle and undergoes no deformation. Further, no product remnants will be left on the supporting structure, which means that no special measures for cleaning the supporting structure need be taken. The product will then also maintain its initial weight. It can easily be passed on to another freezer, for

instance one with a foraminated belt, and be finally frozen therein without any risk of the product freezing fast, or of product waste, impressions or deformation.

The invention will be described in more detail hereinbelow with reference to the accompanying drawing whose only Figure schematically shows an embodiment of an arrangement according to the invention.

The drawing shows from the side an arrangement for freezing the surface of one side of food products, such as shaped ice figures, hamburgers, fish fillets, pieces of chicken, cut fruit and sauce portions. The arrangement has a supporting structure in the form of a plate 1, for instance of stainless steel. The plate 1 has through channels 2 which are connected at one end to a common inlet 3 communicating with a source 4 of a cooling agent, such as cryogenic gas in the form av liquid nitrogen. At the other end, the channels 2 are connected to an outlet 5.

The plate 1 is resiliently mounted by means of springs 6 and connected to a vibrator 7. This can cause the plate 1 to vibrate with such an amplitude and in such a direction that products placed on the plate 1 will be moved along the plate 1 in a predetermined direction. Thus, it is also possible to determine the residence time of the products on the plate 1.

When using the arrangement shown in the drawing for freezing the surface of products, the plate 1 is first given a sufficiently low temperature by leading cryogenic gas through the channels 2 from the source 4 and the inlet 3 to the outlet 5. With the vibrator 7 in operation, the products can thereafter be placed on the upper side of the plate 1. As a result of the low temperature, the products will be frozen in their surface layer nearest the plate 1 without freezing on to it. At the same time the vibrator 7 causes the products to move along the plate at such a speed that the desired surface-freezing has been achieved when the products reach the side edge of the plate 1

located in the direction of movement of the products.

From the plate 1, the products can be passed on to a conventional freezer (not shown) of optional type for final freezing of the products. In this case, the arrangement according to the invention serves as a separate prefreezer. However, it can also be integrated with the final freezer and thus form part thereof.

For the conveyance of the products along the plate 1, it is possible, as an alternative, to use a belt in the form of a film or a cloth which thus runs in direct contact with the plate 1 and supports the products. In this case, the belt is part of the supporting structure. The conveyance can also be provided for in any other suitable way.

Alternatively, the supporting structure need not be vibrated, but may be movable, with the provision of a stationary scraper for removing the products from the supporting structure. A stationary supporting structure in combination with movable scrapers is also conceivable.

In the embodiment now described, the supporting structure may be completely smooth, but may also have a pattern of grooves or depressions. The shape of the supporting structure may generally be conformed to the shape required for each particular product.

Further, the supporting structure should consist of a material having good thermal conductivity and good heat capacity, but it may also be made up of several materials arranged in superposed layers. The topmost layer should then have a particularly good thermal conductivity.

One example of a suitable material for the supporting structure is, as mentioned above, stainless steel, but also other materials, such as aluminium, are conceivable. In the case of stainless steel, it has been found necessary in practical tests in order to prevent the product from freezing on to the supporting structure, to use a temperature of about -90°C, whereas in the case of aluminium the corresponding temperature can be about

-60°C. A variety of other materials and combinations of materials are however possible.

According to a preferred aspect of the invention, the product is maintained on the supporting structure for a sufficient time to cause a product surface layer having a thickness of less than about 5 mm, preferably less than about 1 mm, to pass into the frozen state. This time is normally less than about 30 s, preferably less than about 20 s.

Thus, the invention is not restricted to the embodiment described above, but may be modified by anyone person skilled in the art within the scope defined by the accompanying claims. Although the invention is especially well suited for the surface-freezing of food products intended for individual freezing, whether these products are solid, semi-solid, pasty, semi-liquid or liquid, it is also usable for freezing the surface layer of products which are spread out, irrespective also in this case of the consistency of the products, continuously or batchwise. In the case of a semi-liquid or liquid product, the supporting structure suitably has depressions for receiving the product. In this manner, the product will be provided with a frozen crust enclosing the non-frozen portion of the product. The supporting structure may also be supplemented with cover elements which, together with the supporting structure, form closed cavities for the product. These cover elements should then be given the same temperature as the supporting structure. In both of these latter cases, it is possible to use some type of ejector means for removing the product from the associated depression.

CLAIMS

1. Method for freezing a food product, c h a r a c - t e r i s e d by placing the product on a firm supporting structure which has previously been given such a low temperature that the product when contacting said supporting structure will not freeze on to it, maintaining the product on the supporting structure for a sufficient time to cause its surface layer nearest the supporting structure to pass into the frozen state, and removing the product from the supporting structure for final freezing in a separate freezer.

2. Method as claimed in claim 1, c h a r a c t e - r i s e d in that the supporting structure is given said low temperature by means of a cooling agent.

3. Method as claimed in claim 1 or 2, c h a r a c -t e r i s e d in that the product is maintained on the supporting structure for a sufficient time to cause a product surface layer having a thickness of less than about 5 mm, preferebly less than about 1 mm, to pass into the frozen state.

4. Method as claimed in any one of claims 1-3, c h a r a c t e r i s e d in that the product is maintained on the supporting structure for less than about 30 s, preferably less that about 20 s.

5. Method as claimed in any one of claims 1-4, c h a r a c t e r i s e d in that the supporting structure is maintained at a temperature below about -60°C, preferably below about -90°C.

6. Method as claimed in any one of claims 1-5, c h a r a c t e r i s e d in that the product during the freezing of said surface layer is moved along the supporting structure.

7. Method as claimed in any one of claims 1-6, c h a r a c t e r i s e d in that the supporting structure is vibrated.

8. Arrangement for carrying out the method as claimed in claim 1 for freezing a food product, c h a r a c t e r i s e d by a firm supporting structure (1) on which the product is intended to be placed, means (2-4) for giving said supporting structure such a low temperature that the product when contacting the supporting structure will not freeze on to it, and a separate final freezer to which the product is intended to be fed for final freezing as soon as its surface layer nearest the supporting structure has passed into the frozen state.

9. Arrangement as claimed in claim 8, c h a r a c t e r i s e d in that the means (2-4) for giving the supporting structure said low temperature comprise means for supplying a cooling agent to the underside of the supporting structure.

10. Arrangement as claimed in claim 9, c h a r a c t e r i s e d in that the means (2-4) for supplying the cooling agent comprise channels (2) underneath the supporting structure (1).

11. Arrangement as claimed in any one of claims 8-10, c h a r a c t e r i s e d by a vibrator (7) for vibrating the supporting structure (1).

12. Arrangement as claimed in any one of claims 8-11, c h a r a c t e r i s e d in that the supporting structure (1) has depressions for receiving the product.

13. Arrangement as claimed in claim 12, c h a r a c t e r i s e d by cover elements provided over the depressions to form closed cavities for the product, said cover elements being adapted to be given the same temperature as the supporting structure.

14. Arrangement as claimed in any one of claims 8-10, c h a r a c t e r i s e d in that the supporting structure (1) comprises a movable surface layer in the form of a film or cloth.

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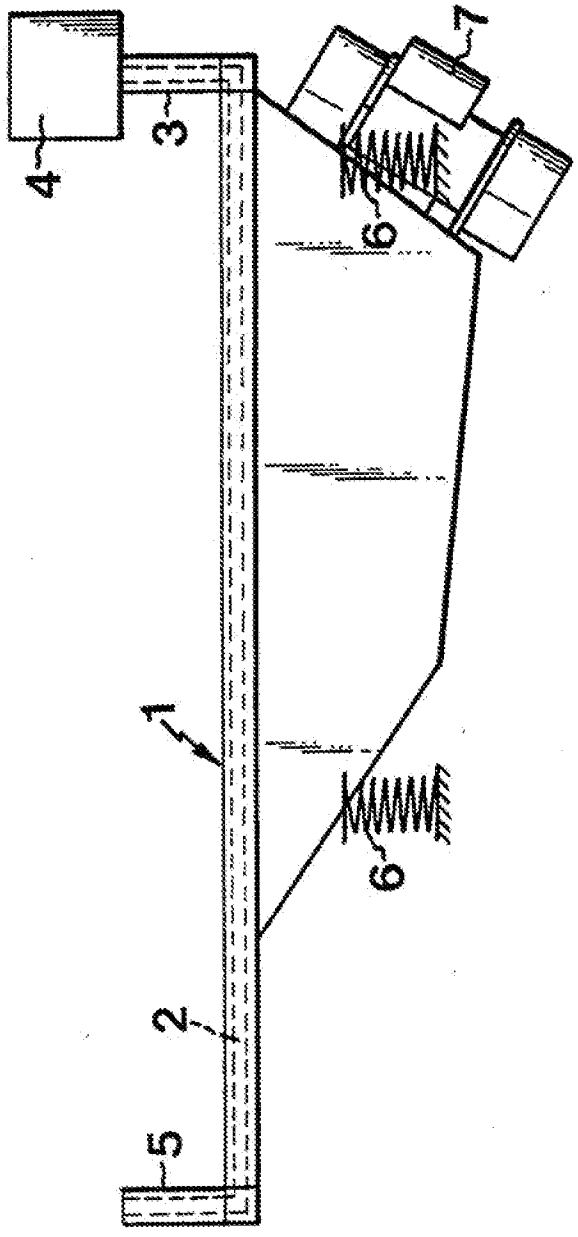

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 89/00745

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: A 23 L 3/36, F 25 D 25/04

II. FIELDS SEARCHED

Minimum Documentation Searched

Classification System | Classification Symbols

IPC5 | A 23 L; F 25 D; F 25 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	SE, B, 439367 (KABUSHIKI KAISHA MAEKAWA SEISAKUSHO) 10 June 1985, see fig 1 and page 2 line 14-21 and line 33-38	1-14
P,A	SE, A, 8702593-9 (FRIGOSCANDIA CONTRACTING AB) 23 JUNE 1987	1-14
A	GB, A, 1441846 (OSAKA GAS KABUSHIKI KAISHA) 7 July 1976, see figure 1	1-14
A	Patent Abstracts of Japan, Vol 11, No 229, C436, abstract of JP 62- 40274, publ 1987-02-21 (TADAAKI SAKAI)	1-14

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IV. CERTIFICATION

Date of the Actual Completion of the International Search

14th March 1990

Date of Mailing of this International Search Report

1990 -03- 22

International Searching Authority

SWEDISH PATENT OFFICE

Signature of Authorized Officer

Kerstin Boije Janson

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 89/00745

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
SE-B- 439367	85-06-10	DE-A-C- 2808837	78-09-07
		JP-A- 53106956	78-09-18
		SE-A- 7802116	78-09-02
		US-A- 4205536	80-06-03
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